The progress of private electric lighting is simply astonishing, the gas engine being generally the motor used. Many of these engines are run by the Dowson gas, made on the spot, thus rendering a supply of illuminating gas unnecessary.

The author treats somewhat in detail the cost of electric lighting in a house, but as this largely depends on the type of pendants, brackets, &c., used, the outlay naturally varies considerably. The most serious item in the maintenance of an installation is the breakage of the lamps. The author rejoices that this monopoly of manufacture will soon expire, when competition will place better lamps on the market at half the present cost.

Taken as a whole this little book is interesting and useful. It will certainly help the uninitiated consumer to study intelligently the principles of electric lighting, and render his conception of necessary expenses when installing the light more sensible.

OUR BOOK SHELF.

Grasses of the Pacific Slope, including Alaska and the adjacent Islands. Part I. By Dr. Geo. Vasey, Botanist, U.S. Department of Agriculture. 8vo, 50 plates, with descriptions. (Washington: Government Printing Office, 1892.)

THE botanists of the United States Department of Agriculture are working very energetically, and the importance of the herbarium, library, and its publications is increasing year by year. The present work is part of a series of illustrations of the North American grasses, of which we have already noticed two parts, together making one volume, devoted to descriptions and figures of the characteristic species of the South-Western States. The present part, which will constitute half a volume, is devoted to California and the Western States. Dr. Vasey tells us in his introduction that the grasses which are known to grow on the Pacific slope of the United States, including Alaska, number not far from 200 species, which is nearly twice as many as we get in the British Islands. They are all specifically distinct from the grasses growing east of the Mississippi, and also mostly distinct from the grasses of the plains and of the desert, except in that part of California which partakes of the desert flora. A considerable number of the grasses of the mountainous regions of California, Oregon, and Washington reappear in the mountains of Idaho, Montana, and the interior Rockies. The interior of California is a dry region, verging in the extreme south into the desert country, and is deficient in grasses, especially of those species which form a continuous turf. In the present publication fifty of the most interesting species are described and illustrated.

The descriptions are almost wholly the work of Dr. Vasey's assistant, Prof. L. H. Dewey. The illustrations are excellent, and are the work of various artists—F. Muller, W. R. Scholl, T. Holm, and others, and are accompanied by full dissections. The species range under the genera as follows:—Imperata, 1; Panicum, 1; Cenchrus, 1; Phalaris, 2; Hierochloe, 1; Aristida, 1; Spipa, 9; Oryzopsis, 2; Muhlenbergia, 5; Alopecurus, 7; Agrostis, 6; Calamagrostis, 10; Deschampsia, 1; Trisetum, 3; Orcuttia, 2. Only two out of the fifty species are British, *Alopecurus geniculatus* and *Deschampsia cæspitosa.*

J. G. B.

Aids to Experimental Science. By Andrew Gray. (Auckland: Upton and Co., 1892.)

THE chief interest of this little book lies in the fact that it gives a glimpse of the science teaching in one of our colonies. It is a compilation of simple experiments in mechanics, physics, chemistry, physiology and health, and agriculture, to prepare students for what is known as the Class D examination. Naturally, most of the experiments are old ones, but here and there one may gather a new idea. The portion dealing with physiology and health has nothing to do with dissection, but consists of experiments on ventilation, drainage, food stuffs, and the like. An interesting piece of apparatus, devised by Prof. Bickerton for showing the action of the lungs, is described on p. 76. All the experiments are briefly but sufficiently described, and many of them are illustrated.

Science in Arcady. By Grant Allen. (London: Lawrence and Bullen, 1892.)

THIS volume will fully maintain Mr. Grant Allen's reputation as a popular writer on science. The essays of which it consists are written in a bright, lively style, and may be read with pleasure even by original investigators, for the truths with which they deal, if not new, are at least presented from new points of view. Readers who do not profess to know much about any particular branch of science will find in these papers an excellent introduction to some of the more attractive facts and laws of the natural world. The volume includes some archæological essays, which show very effectually that an antiquary has not necessarily much resemblance to Dr. Dryasdust.

LETTERS TO THE EDITOR.

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Macculloch's Geological Map of Scotland.

IN a recent article in this journal Prof. A. H. Green writes as follows:—

"Macculloch seems to have projected, but never completed, a geological map of the whole of Scotland. The materials collected by him were, however, utilized by the Highland Society in the construction of a general map in 1832."

I am sure that nothing could be farther from the wish of the Oxford Professor than to do an injustice to the memory of one of the greatest of the pioneers in British geology, and he will therefore forgive my calling attention to the following facts, which, judging from a subsequent letter in these pages, would seem not to be generally known.

During the last twenty years of his life Dr. John Macculloch was engaged on a regular survey of Scotland, and in collecting the materials for a geological map of the country. In the earlier part of this period Macculloch seems to have availed himself of the opportunities afforded to him as an official of the Board of Ordnance to carry on his valuable geological explorations. But during the latter part of the period he was regularly employed by Government to complete his geological work, and was paid by the Lords of the Treasury, who in the end published his map.

On July 28, 1834, Macculloch addressed to "His Majesty's Treasury" a series of memoirs respecting the Geological Map of Scotland, which was then completed. In these memoirs he refers to the map as being then in existence, and gives the most minute directions concerning the tints to be employed by the colourists who were to copy the map, in order that it might correspond with his original work. He also expressed his regret that the imperfect topography of the map on which his researches had to be recorded prevented the work from being as accurate as he could have wished at certain points.

Owing to delays in issuing the Government publications—not quite without parallel in more recent times—Macculloch's "Memoirs on the Geological Map of Scotland" did not appear till the year following his death (1836). The date at which the first copies of the map were issued it would probably be difficult to determine, but as to the completion of the map before July 1834,

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and its subsequent issue by "the Hydrographer to the King by order of the Lords of the Treasury" there can be no doubt whatever.

The first Government Geological Survey undertaken in the British Islands was that of Dr. John Macculloch, and the work that he accomplished single-handed was a very remarkable one. Several geological maps of Scotland, differing very widely from that of Dr. John Macculloch, have been issued and withdrawn during the last fifty years; but any one who will compare the first geological map of Scotland with the latest, also "published with Government authority," will be interested to see how far the work of the early pioneer in Scottish geology has been found to be correct in most of its essential features by those who have come after him.

John Macculloch's title to be the author of the first geological map of Scotland is as indisputable as are the similar claims of William Smith and Richard Griffiths with respect to England and Ireland respectively. JOHN W. JUDD.

16, Cumberland Road, Kew, December 6.

Glaciers of Val d'Herens.

THE two glaciers of Arolla are interesting, inasmuch as one, the Arolla, is retreating, while the other, Glacier de Zigiorenove, is advancing. This has been going on for twelve years, according to the report which appeared in NATURE (vol. xlvi. p. 386), by Dr. Forel, dealing with Alpine glaciers and their changes.

Having visited these glaciers last summer with the object of observing the effect of their respective movements upon the morainic accumulations in front, I think a brief account may be worth recording.

The Arolla glacier occupies the head of the valley, and is fed by the snow from Mont Colon and the fields of nevé extending towards Mont Brulè. The Zigiorenove glacier is one mile further down the valley, but does not descend so low as the Arolla glacier by about 300 feet. It receives its main supply from the Pigne d'Arolla, a mountain which rises immediately above the glacier, and is conspicuous by its massive snow-cap. This glacier is not only nearer to its supply, but descends at a steeper gradient than the Arolla glacier.

This may in some measure account for the former advancing while the latter is retreating, or, more correctly speaking, melting backwards. I was informed by local guides that the Arolla glacier has been swelling behind for some years; if this be correct, and the seasons remain normal, then, in a short time, this glacier must advance also; in other words, being longer or further away from its feeding ground, the extra supply has not yet had time to reach its extremity. Appearances at the end of the glaciers are in themselves quite sufficient to indicate their respective movements; the snout of the Arolla glacier is buried in its own debris, composed of rocks and loam borne upon or concentrated to the surface as the ice melts. This debris is being constantly shot down grooves or water-courses furrowed in the sloping end or side of the glacier. At the bottom of these spout-like grooves conical-shaped mounts are formed, one behind another, as the ice melts backwards, resulting in a moundy, zigzag arrangement constantly seen lower down the valley, many miles away from existing glaciers, and can be seen also in many of the higher valleys of North Wales.

The advancing Zigiorenove glacier, instead of being buried in debris, turns up in shell-like flanges, exposing its under surface in its endeavour to climb over, rather than push forward, the loose rocks in front; a part of this loose material only is pushed forward, forming a small bank, which in no place exceeded 5 feet in height, up which the ice mounts with the shell-like flanges projecting beyond; the under part of these projections being fluted into a perfectly symmetrical pattern.

In some way the projecting rocks forming the glacier bed produced these convolutions, but whether by cutting, melting, or by the ice crystals flowing round each side, I was unable to determine, but I may state there was no appearance of cutting or grinding which would necessarily leave behind the shavings or ice particles cut out or ground off, and little or no water was present as if from melting. We had much snow for three days, with a total absence of sunshine; the atmosphere at mid-day, when making these observations, registered 38° F. Appearances rather suggested the idea that the ice crystals were displaced in a similar manner to water in a rapid river when it meets with obstructing boulders in its bed.

Climbing up one of the old lateral moraines, for there are several, the glacier is seen to be encroaching laterally as well as longitudinally; it soon extends to the base of the inner moraine, and then climbs upwards in a similar manner as it advances in front by turning up its edges, carrying upwards a few loose rocks in front, but without materially disturbing the moraine itself. Higher up it reaches the top of this moraine, and then rises above it like a wall, having caused the loose rocks it had borne up to roll down into the valley between the inner and outer moraine, with masses of ice broken off the edge of the glacier.

As far as I am able to ascertain, by creeping under the flanges the glacier slowly spreads out the bank which it had pushed up in front as it advances into a more even bed to travel over, but my observations were restricted to a few yards owing to the contraction of the sub-glacial space between the ice roof and the floor. I was much impressed by the fact that the glacier did little in exerting that force which might be expected from such a power behind, in the way of ploughing through or removing such comparatively trifling obstructions as loose rocks or moraine banks.

It is evident from the various ages of moraines that the lower parts of those glaciers have fluctuated considerably during recent times, but the line of demarcation between these minor fluctuations and the period after these lateral valley glaciers had been confluent with the main Valais glacier, and were retreating backwards, is very marked. Beyond two miles down the valley from the Zigiorenove glacier no striæ from the trunk glacier could be found, but at this distance it suddenly appears with fresh glaciated forms; precisely the same phenomenon was noticed in the neighbouring Val d'Anniviers, as if this were the limit of the more recent fluctuations.

At the Col de Bertol, 4500 feet above Arolla, or about 11,000 feet above sea level, there are no indications of glaciation, ancient or modern, above the surface of the snow; so it would appear, however much the ice level has varied below, at this dividing ridge it has always remained the same, or, in other words, it has been dispersed by wind or ice movements to lower levels at a rate equal to deposition, when the snow line was low enough to allow the ice to travel down the Val d'Herens, the higher ice streams would simply run down upon its surface, instead of descending as low level glaciers or mountain rivers, as at present.

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Ancient Ice Ages.

MESSRS. BLANFORD, in their letter (NATURE, p. 101) called forth by Dr. Wallace's notice of a palæozoic glacial conglomerate in Victoria, Australia, say:—"It has become an accepted article of faith amongst most European geologists that no ice-age occurred before the last glacial epoch." There is no doubt that the tendency of opinion has been in that direction, notwithstanding the evidences to the contrary brought forward by Dr. Blanford and others. The late Sir Andrew Ramsay was the first, so far back as 1855, to suggest that the Permian conglomerate of Abberley and the Clent hills was an ancient glacial deposit. Although this reading was accepted by so cautious a philosopher and critic as Sir Chas. Lyell ("Principles," 10th ed., vol. i. p. 223), the idea has languished from disfavour. Having devoted a considerable portion of the last twenty years to the study of glacial phenomena, I early this year paid my first visit to the district. The best section I saw is an excavation at Abberley in what may be called boulder-gravels, and, except for its prevailing red colour, the deposit, if dropped down on the coast of Wales, would, in general appearance and arrangement of the materials, be undistinguishable from many of the glacial deposits to be found there. Many of the stones have flattened faces, and in general shape resemble glaciated boulders, but the striæ, so far as I could observe in the limited time at my disposal, were not very pronounced. Since then I have found a deposit of glaciated gravels on the top of the Screes, Cumberland, 1600 feet above the sea, which on comparison with the specimens brought home from Abberley enables me to understand the latter better. The volcanic rocks of the lake district of which these gravels are composed break up into very similar shapes, and are planed and striated in a very similar way to those of Abberley. I also brought home from Abberley two specimens of the "paste" which fills up the interstices of the finer gravel

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